

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
18 January 2001 (18.01.2001)

PCT

(10) International Publication Number
WO 01/05157 A2

(51) International Patent Classification: H04N 7/24

(21) International Application Number: PCT/US00/16928

(22) International Filing Date: 20 June 2000 (20.06.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/143,611 13 July 1999 (13.07.1999) US

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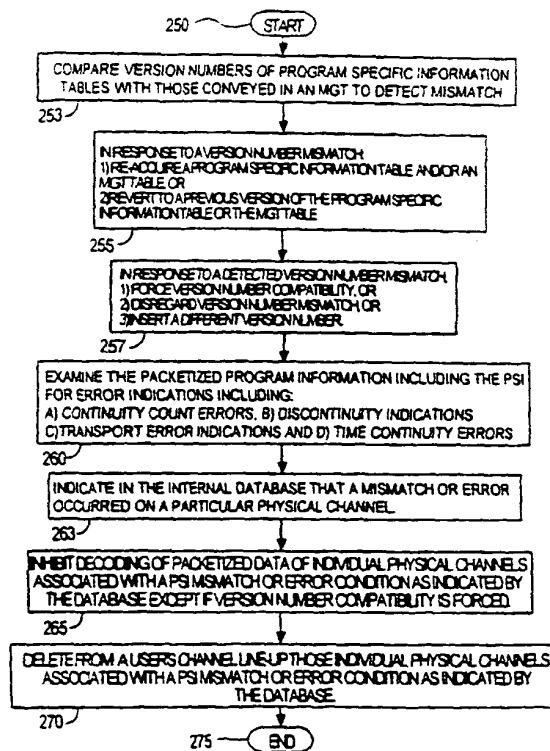
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(81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian

[Continued on next page]

(54) Title: SYSTEM FOR PROGRAM SPECIFIC INFORMATION ERROR MANAGEMENT IN A VIDEO DECODER



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patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Published:

— *Without international search report and to be republished upon receipt of that report.*

(57) Abstract: A processing system decodes packetized program information including ancillary program specific information comprising a plurality of hierarchically ordered information tables. The ancillary information is used in acquiring and decoding packetized program information to provide a video program for display. The processing system employs a method involving detection of a mismatch between a version number of a first table of the program specific information (e.g. a virtual channel table (VCT), or channel information table (CIT)) and a corresponding version number of the first table conveyed in a second table (e.g. a master guide table (MGT)). If a mismatch is detected, the first and second tables are forced to contain a compatible first table version number. The packetized program information is decoded to provide a video program for display using the program specific information including the first and second tables including the forced compatible version number. A detected mismatch may also be disregarded to enable the decoding of the packetized program information and a User's channel line-up may be edited to remove channels associated with a detected mismatch or other program specific information error condition.

5 System for Program Specific Information Error Management in a Video Decoder

Background

10 This invention is related to the field of digital signal processing, and more particularly to the processing of imperfect program specific information for use in the acquisition and decoding of packetized video, audio and other information.

15 In video broadcast and processing applications, digital video data is typically encoded to conform to the requirements of a known standard. One such widely adopted standard is the MPEG2 (Moving Pictures Expert Group) image encoding standard, hereinafter referred to as the "MPEG standard". The MPEG standard is comprised of a system encoding section (ISO/IEC 13818-1, 10th June 1994) and a video encoding section (ISO/IEC 13818-2, 20th January 1995). Data encoded to the MPEG standard is in the form of a packetized datastream which typically includes the data content of many program channels (e.g. content
20 corresponding to cable television channels 1-125). Further, several digital services and channels may occupy the frequency spectrum previously occupied by a single analog channel. A 6 MHz bandwidth previously allocated to an analog NTSC compatible broadcast channel may now be split into a number of digital sub-channels offering a variety of services. For example, the broadcast spectrum for RF channel 13
25 may be allocated to sub-channels including a main program channel, a financial service channel offering stock quotes, a sports news service channel and a shopping and interactive channel. In addition, data conveyed in different sub-channels may be in different data formats (e.g. analog, digital etc.).

30 In such a digital video system, the processing of ancillary program specific information used in acquiring and decoding packetized data for display on a TV, for example, presents a number of problems. The ancillary program specific information includes data used in identifying and assembling packets comprising selected programs and also includes program guide and text information associated with the transmitted program data. The ancillary program specific information is
35 derived from different broadcast sources e.g. from each broadcaster such as ABC, CBS, NBC, etc., and collated and transmitted as composite program specific information in a packetized datastream together with the program content data of many program channels (e.g. channels 1-125). As a result of this processing, the ancillary program specific information received by a video decoder following
40 transmission may include errors. These errors may be introduced through the collation process, or through broadcaster misunderstandings and incompatibilities as

5 well as through data corruption caused by the transmission process itself. A system, according to the invention principles, acquires and processes ancillary program specific information to alleviate the problems created by these errors.

Summary

10

A processing system decodes packetized program information including ancillary program specific information comprising a plurality of hierarchically ordered information tables. The ancillary information is used in acquiring and decoding packetized program information to provide a video program
15 for display. The processing system employs a method involving detection of a mismatch between a version number of a first table of the program specific information (e.g. a virtual channel table (VCT), or channel information table (CIT)) and a corresponding version number of the first table conveyed in a second table (e.g. a master guide table (MGT)). If a mismatch is detected, the first and second tables are
20 forced to contain a compatible first table version number. The packetized program information is decoded to provide a video program for display using the program specific information including the first and second tables including the forced compatible version number.

In another feature, a detected mismatch is disregarded to enable the
25 decoding of the packetized program information. In addition a User's channel line-up is edited to remove channels associated with a detected mismatch or another program specific information error condition.

In the drawing:

30

Figure 1 shows an exemplary Master Guide Table (MGT) conveying version numbers of program specific information tables.

Figure 2 shows an exemplary Virtual Channel Table (VCT) containing
35 its own version number.

Figure 3 shows a flowchart of a method for managing error conditions in processing program specific information for video and audio decoding applications, according to the invention.

40

5 Figure 4 shows a decoder system for decoding packetized program information using the process of Figure 3, according to the invention.

Detailed Description of the Drawings

10 Program specific information (PSI) includes program guide data and information for use in identifying and assembling individual data packets to recover the content of selected program channels. Program specific information may be conveyed in MPEG compatible format (per section 2.4.4 of the MPEG systems standard) or may be conveyed in a format compatible with the *Program and System*
15 *Information Protocol for Terrestrial Broadcast and Cable*, published by the Advanced Television Systems Committee (ATSC), 23 December 1997, hereinafter referred to as the PSIP standard or other ATSC standards. Further, the data structure elements may be formed in accordance with proprietary or custom requirements of a particular system. Program specific information is typically structured into
20 multiple hierarchically arranged and inter-linked tables. The tables consist of arrays of data and parameters which are used to enumerate and describe collections or sequences of TV channels, TV programs, channel parameters, program parameters, associated multimedia objects and object parameters, etc. An exemplary PSIP hierarchical table arrangement includes a Master Guide Table (as exemplified in the
25 PSIP compatible MGT of Figure 1), Virtual Channel Tables (VCT-1, VCT-2, etc. (as exemplified in the PSIP compatible VCT of Figure 2), Event Information Tables (EIT-1, EIT-2), and optional tables such as Extended Channel Information Tables (EVCT-1, EVCT-2, EVCT-3), a Network Information Table (NIT) and Extended Event Information Tables (EEIT-1, EEIT-2).

30 The MGT (e.g. as shown in Figure 1) contains information for use in acquiring program specific information conveyed in other tables including a VCT (e.g. as shown in Figure 2). Specifically, the MGT contains a list including the version number, length, and Packet Identifier (PID) of all other PSIP tables that are being sent on an individual channel. The other tables also contain their respective
35 individual version numbers, which in normal operation, should match their corresponding version number conveyed in the MGT. The VCT contains a list of attributes for channels that are carried in a particular transport stream and includes information for tuning and navigation to receive a User selected program channel. The EIT contains descriptive lists of programs (events) receivable on the channels
40 listed in the VCT. Either a VCT, EIT or other table may be used to convey information enabling a user to select and tune to a particular program. A VCT is

5 typically used to convey parameters for acquiring audiovisual program content data that remains constant over several events (TV programs). An EIT is typically used to convey parameters of audiovisual program content data that remain constant for an event (individual TV program). The NIT (an optional table) contains parameter lists for the entire broadcast network (terrestrial, satellite, cable, etc.). The EVCT and
10 EEIT are extension tables accommodating additional VCT and EIT information. Additional program specific information describing and supplementing items within the hierarchical tables is conveyed within descriptor information elements.

The inventors have recognized that a problem may occur in performing a validity check of version number compatibility for individual program specific
15 information tables. A validity check for a VCT, for example, involves comparison of the VCT version number conveyed within the VCT itself with the corresponding VCT version number conveyed within the MGT. Similar version number checks are performed for the other program specific information tables. A version number incompatibility may arise for a number of different reasons. A broadcaster may
20 erroneously transmit an MGT and VCT that have incompatible version numbers, but that are in all other respects valid, for example. Alternatively, a version number mismatch may occur if, after an MGT is acquired, but before a VCT is acquired, program specific information tables are updated. The updated tables contain new version numbers and this results in the MGT conveying an older VCT version number
25 than the version number of the acquired VCT. Version number incompatibility may also arise from data corruption in the transmission or acquisition process and in other ways.

In a decoding system, upon detection of a version number incompatibility between an MGT and VCT, for example, one initial response is to re-
30 acquire the VCT. The VCT is typically re-acquired rather than the MGT because the MGT is monitored more frequently and is therefore more likely to be current. The MGT is more frequently monitored for changes because it comprises an index of the version numbers of the other tables and therefore the MGT may be efficiently used to determine which other tables have changed and need to be re-acquired.

35 If a broadcaster erroneously transmits an MGT and VCT that have incompatible version numbers, but that are in all other respects valid, the re-acquisition of either the VCT or MGT does not resolve the incompatibility. This is because under these conditions the MGT will never match the VCT. This may potentially produce a failure mode involving continuous re-acquisition of a VCT or
40 MGT. In contrast, if a version number mismatch occurs through the intervening update of program specific information tables occurring between the acquisition of an

5 MGT and a VCT, the re-acquisition of the VCT successfully resolves the incompatibility. However, the version number incompatibility is resolved at the expense of incurring additional delay in re-acquiring the VCT. The re-acquisition of the VCT also may successfully resolve version number incompatibility (at the expense of the additional delay) arising from data corruption in the MGT and VCT
10 transmission or acquisition process. Once the version number incompatibility is resolved channel information may be retrieved from the VCT and used for tuning and navigation to receive a User selected program channel.

The inventors have recognized that the version number incompatibility and associated re-acquisition delay problems may be minimized or eliminated by
15 advantageously forcing compatibility of a VCT (or other table) version number and the corresponding version number conveyed in an MGT (or other table). Specifically, the MGT may be modified in memory when a VCT (with a different corresponding version number to that conveyed within the MGT) is initially acquired. Therefore, when the MGT and VCT are checked for validity, the version numbers match, and
20 channel information from the VCT may be used in channel acquisition. In another embodiment, the version number incompatibility may be disregarded and the VCT information used for channel acquisition provided that there is an absence of other indications of a disabling corruption of the VCT or MGT data.

The principles of the invention may be applied to terrestrial, cable,
25 satellite, Internet or computer network broadcast systems in which hierarchically structured program specific information is communicated. Such systems may include, for example, non-MPEG compatible systems, involving other types of encoded datastreams and other methods of conveying program specific information. Such other methods may employ transport structures including, for example, MPEG-PSI,
30 Internet TCP/IP (Transport Control Protocol/Internet Protocol), DSS (Digital Satellite System), ATM (Asynchronous Transfer Mode) etc. Further, although the disclosed system is described as processing broadcast programs, this is exemplary only. The term 'program' is used to represent any form of packetized data such as audio data, telephone messages, computer programs, Internet data or other communications, for
35 example.

Figure 3 shows a flowchart of a method for managing version number incompatibility and other error conditions in processing program specific information for video and audio decoding applications. The method of Figure 3 is used for processing the exemplary PSIP compatible MGT and VCT of Figures 1 and 2
40 respectively. The VCT processed in Figure 3 associates RF or Physical Transmission Channels (PTCs) with sub-channels (also termed virtual or logical channels). Each

5 Physical Transmission Channel (PTC) is allocated a 6 MHz bandwidth and contains, for example, up to 6 sub-channels. The Figure 3 process is used in a decoder in acquiring program specific information including a PSIP compatible MGT and a VCT. The acquired program specific information is used for acquiring a User selected sub-channel and corresponding PTC. The process of Figure 3 is used each time
10 program specific information is updated, which typically occurs on a periodic basis, but also occurs upon User selection of a new channel on a different PTC to the PTC currently selected. If a User selects a different sub-channel associated with the already selected PTC it is unnecessary to acquire a new VCT.

Following the start at step 250 of Figure 3, in step 253, version
15 numbers of program specific information tables are compared with corresponding version numbers conveyed in an MGT in order to detect a mismatch. Specifically, a VCT version number (item 140 of Figure 2) is compared with the corresponding VCT version number conveyed in an MGT (item 135 of Figure 1).

In response to a detected mismatch, in step 255, the VCT (and/or
20 MGT) is repetitively re-acquired for a limited number of times until the version number incompatibility is resolved. In another embodiment, a previous version of the VCT or MGT providing version number compatibility may be used in response to a detected mismatch. Alternatively, step 255 may be omitted with the process continuing at step 257.

25 In step 257, in response to a detected mismatch (with or without the table re-acquisition of step 255), the VCT version number and the corresponding version number conveyed in an MGT are advantageously forced to be compatible. This is done by substituting (or overwriting) the VCT version number conveyed in the MGT with the VCT version number conveyed in the VCT itself. Alternatively, this
30 may be done by substituting (or overwriting) the VCT version number conveyed in the VCT with the VCT version number conveyed in the MGT. Therefore, when the MGT and VCT are checked for validity, the version numbers match and channel information from the VCT may be used in subsequent channel acquisition. As a further alternative, both the VCT version number conveyed in the MGT and the VCT
35 version number conveyed in the VCT itself may be set to a common value that is different to either original version number. This common version number value may be employed to indicate that a mismatch condition has occurred in acquiring a VCT for a particular physical transmission channel. The common value may further be used to trigger application of special error detection and/or correction processing to
40 the VCT (or MGT) to ensure that the VCT (or MGT) is not disabled from use by data corruption.

5 In another embodiment, in step 257, the detected version number incompatibility may be disregarded and the VCT information used for channel acquisition even though there is a version number incompatibility. In an alternative embodiment however, the version number incompatibility is only disregarded if there are no other error indications (as exemplified by those described in following step 10 260) of a disabling corruption of the VCT or MGT data.

 The packetized program information is examined in step 260 for error indications. Specifically, the packetized program information (including program specific information) is examined for, (a) an MPEG continuity count error, (b) an MPEG discontinuity error, (c) an MPEG transport error, and (d) an error indicated by 15 a variance between successive time stamps. These indicators are defined within the MPEG systems standard (e.g. in section 2.4.3.5 and other places) or the error indicators are derived from MPEG compatible parameters. The detection of such an error condition, or of a table version number mismatch condition, occurring on a particular physical transmission channel, is recorded in a database in step 263. 20 Specifically, the database is updated in step 263 to associate a particular sub-channel and corresponding physical transmission channel with the detected error or mismatch condition.

 In step 265, the decoding of the packetized program information is inhibited for those physical transmission channels associated with a version number 25 mismatch or other error condition as indicated by the database. Therefore, if version number compatibility is being forced or is being disregarded in step 257 and no error condition is detected in step 260, then packetized program information is decoded in step 265 to provide a video or audio program for reproduction on a display or audio device. The database is further used in step 270 to delete those channels associated 30 with a version number mismatch or error condition from a User's channel line-up. The channels associated with a fault condition may be deleted from a User's viewable channel line-up that is displayed in the form of an electronic program guide (EPG) or in the form of another channel list. Alternatively, the channels associated with a fault condition may be identified to a User by a visual indication in an EPG or other 35 channel list as being associated with a fault condition (and may therefore indicate that the channel is unobtainable). Such fault indications may be advantageously used in a diagnostic or tuning procedure. The process of Figure 3 may be employed as part of a scanning process for initializing a video decoder to determine a User's available channel line-up in a particular geographic location, for example. The process of 40 Figure 3 terminates at step 275.

5 Figure 4 shows a block diagram of a digital video decoder system for decoding packetized program information using the process of Figure 3. Specifically, the system of Figure 4 demodulates and decodes broadcast (terrestrial, satellite, cable, or Internet) signals. In terrestrial mode, a carrier modulated with signals carrying program representative MPEG compatible audio, video and associated data received
10 by antenna 10, is converted to digital form and processed by input processor 13. Processor 13 includes radio frequency (RF) tuner and intermediate frequency (IF) mixer and amplification stages for down-converting the input signal to a lower frequency band suitable for further processing. In this exemplary system, the terrestrial input signal received by antenna 10 contains 125 Physical Transmission
15 Channels (PTCs 0-124). Each Physical Transmission Channel (PTC) is allocated a 6 MHz bandwidth and contains, for example, up to 6 sub-channels.

It is assumed for exemplary purposes that a video receiver user selects a sub-channel (SC) for viewing using remote control unit 70. Processor 60 uses the selection information provided from remote control unit 70 via interface 65 to
20 appropriately configure the elements of decoder 100 to receive the PTC corresponding to the selected sub-channel SC. Following down conversion, the output signal from unit 13 for the selected PTC has a bandwidth of 6 MHz. In the following discussion, an RF channel or Physical Transmission Channel (PTC) refers to an allocated broadcaster transmission channel band which encompasses one or more sub-
25 channels.

Processor 60 configures the radio frequency (RF) tuner and intermediate frequency (IF) mixer and amplification stages of unit 13 to receive the selected PTC using bi-directional control and signal bus C. The down-converted frequency output for the selected PTC is demodulated by unit 15. The primary
30 functions of demodulator 15 are recovery and tracking of the carrier frequency, recovery of the transmitted data clock frequency, and recovery of the video data itself. Unit 15 also recovers sampling and synchronization clocks that correspond to transmitter clocks and are used for timing the operation of processor 13, demodulator 15 and decoder 17. The recovered output from unit 15 is provided to decoder 17.

35 The output from demodulator 15 is mapped into byte length data segments, deinterleaved and Reed-Solomon error corrected according to known principles by unit 17. In addition, unit 17 provides a Forward Error Correction (FEC) validity or lock indication to processor 60. Reed-Solomon error correction is a known type of Forward Error Correction. The FEC lock indication signals that the Reed-
40 Solomon error correction is synchronized to the data being corrected and is providing a valid output. It is to be noted that the demodulator and decoder functions

5 implemented by units 13, 15 and 17 are individually known and generally described, for example, in the reference text *Digital Communication*, Lee and Messerschmidt (Kluwer Academic Press, Boston, MA, USA, 1988).

In other modes satellite, cable and Internet data is received on input lines 11, 14 and 18 and processed by interface access modules 74, 78 and 72
10 respectively. Interface modules 74, 78 and 72 incorporate interface functions for satellite, cable and Internet format data respectively. Such functions are known and detailed in applicable standards and other documents. These interface functions correspond to those performed by units 13, 15 and 17 in terrestrial mode. Further, in similar fashion to terrestrial mode, processor 60 configures units 74, 78, 72 and
15 decoder 100 to receive satellite, cable or Internet data using bi-directional control and signal bus C. Decoder 100 processes the data conditioned by units 74, 78 or 72 in these other modes using similar functions as described for terrestrial mode.

The corrected output data from unit 17 is processed by MPEG compatible transport processor and demultiplexer 22. The individual packets that
20 comprise either particular program channel content, or program specific information, are identified by their table identifiers (table Ids) and/or Packet Identifiers (PIDs). Processor 22 separates data according to type based on an analysis of Packet Identifiers (PIDs) contained within packet header information and provides synchronization and error indication information used in subsequent video, audio and
25 data decompression.

The corrected output data provided to processor 22 is in the form of a transport datastream containing program channel content and program specific information for many programs distributed through several sub-channels. The program specific information in this exemplary description describes sub-channels
30 present in a transport stream of a particular PTC. However, in another embodiment the program specific information may also describe sub-channels located in other PTCs and conveyed in different transport streams. Groups of these sub-channels may be associated in that their source is a particular broadcaster or they occupy the transmission bandwidth previously allocated to an analog NTSC compatible
35 broadcast channel. Further, individual packets that comprise a selected program channel in the transport stream are identified and assembled by processor 60 operating in conjunction with processor 22 using PIDs contained in the program specific information.

The program specific information is acquired and assembled by
40 processor 60, operating in conjunction with unit 22, from the datastream input from unit 17. Processor 60 determines from the FEC lock indication provided by unit 17

5 that valid data is being provided to transport processor 22. Thereupon, the program specific information MGT and VCT tables are identified and assembled using predetermined table ID and PID values stored within processor 60 internal memory. Using Control signal C, processor 60 configures transport processor 22 to select the data packets comprising the remaining program specific information including the
10 EIT, ETT and NIT data. The tables may be acquired by processor 60 initiating communication with different sources (e.g. satellite, cable, or Internet sources), in different data formats and transmission protocols via different transmission media such as via satellite feed 11, cable line 14 or phone line 18.

Processor 22 matches the table IDs and PIDs (or other data identifiers
15 e.g. TCP/IP identifiers, SCIDs etc.) of incoming packets provided by unit 17 (or units 72, 74 and 78 for Internet, cable or satellite data sources) with table ID and PID values pre-loaded in control registers within unit 22 by processor 60. Further, processor 60 accesses, parses and assembles the program specific information packets captured by processor 22 and stores the program specific information within its
20 internal memory.

In acquiring and processing the hierarchically organized tables comprising the program specific information for the selected sub-channel SC, processor 60 employs the previously described process of Figure 3. Processor 60 in conjunction with decoder 100 compares version numbers of program specific
25 information tables with corresponding version numbers conveyed in the MGT in order to detect a mismatch. In response to a detected mismatch, processor 60 forces the VCT version number and the corresponding version number conveyed in the MGT to be compatible. For this purpose, processor 60 substitutes (or overwrites) the VCT version number conveyed in the MGT with the VCT version number conveyed
30 in the VCT itself. Therefore, when the MGT and VCT are subsequently checked for validity, the version numbers match, and channel information from the VCT may be used in subsequent channel acquisition. Processor 60 also examines the captured packetized program information for error indications. Specifically, processor 60 examines the packetized program information (including program specific
35 information) for MPEG continuity count, discontinuity and transport errors and also examines successive presentation time stamps (PTSs) for excessive variation. Processor 60 updates an internal database to indicate the detection of an error or table version number mismatch condition is associated with sub-channel SC and its corresponding physical transmission channel.

40 Processor 60 inhibits decoder 100 from decoding the packetized program information for those physical transmission channels associated with a

5 version number mismatch or other error condition as indicated by the database. Therefore, if version number compatibility was previously forced and no error condition is detected decoder 100 decodes the packetized program information to provide a video or audio program for reproduction on display 50 or audio device 55. Processor 60 also employs the database to delete those channels associated with a
10 version number mismatch or error condition from a User's channel line-up and electronic program guide (EPG) listing.

In response to a channel SC selection command from remote unit 70 via interface 65, processor 60 derives tuning parameters including PTC carrier frequency, demodulation characteristics, and sub-channel PIDs, from the acquired
15 program specific information. Processor 60 uses this information in configuring units 13, 15, 17 and decoder 100 elements to acquire selected sub-channel (SC) program content.

The packetized decoded transport stream input to decoder 100 from unit 17 (or units 72, 74 or 78) contains video, audio and data representing TV
20 programs, for example, and also contains sub-picture data. The sub-picture data contains picture elements associated with programs and channels selectable by a user for viewing including, multimedia objects, program guides, display commands, subtitling, selectable menu options or other items, for example. As such, the sub-picture data includes an EIT containing descriptive lists of programs (events)
25 receivable on the sub-channels listed in a VCT and also contains an ETT containing text messages describing programs and program sub-channels.

The video, audio, data and sub-picture data being transmitted on terrestrial sub-channel SC, together with associated data from satellite, cable or Internet sources from units 74, 78 and 72, is acquired by processor 60 operating in
30 conjunction with unit 22. This is achieved using the collated program specific information. Processor 60 identifies the video, audio, data and sub-picture data using respective PIDs (or other identifiers) determined from the VCT and descriptors. Processor 60 also initiates communication with other data sources (e.g. cable, satellite or Internet sources) in order to acquire video, audio, data and sub-picture data from
35 these sources.

Processor 22, matches the PIDs (or other identifiers) of incoming packets provided by decoder 17 and interface units 72, 74 and 78 with identifier values of the video, audio and sub-picture data being transmitted on sub-channel SC and also being input via communication lines 11, 14 and 18. In this manner, processor
40 22 captures packets constituting the program transmitted on sub-channel SC and associated data and multimedia objects (e.g. advertisements, web page data,

5 interactive icons etc.). Processor 22 forms these packets into MPEG compatible video, audio and sub-picture streams for output to video decoder 25, audio decoder 35 and sub-picture processor 30 respectively. The video and audio streams contain compressed video and audio data representing the selected sub-channel SC program content. The sub-picture data contains multimedia objects and EIT and ETT
10 information associated with the sub-channel SC program content and program guide information.

Decoder 25 decodes and decompresses the MPEG compatible packetized video data from unit 22 and provides decompressed program representative pixel data to NTSC encoder 45 via multiplexer 40. Similarly, audio
15 processor 35 decodes the packetized audio data from unit 22 and provides decoded and amplified audio data, synchronized with the associated decompressed video data, to device 55 for audio reproduction. Processor 30 decodes and decompresses sub-picture data including multimedia objects received from unit 22 to provide image representative multimedia object, text, caption and graphics data.

20 Processor 30 assembles and formats the decoded and decompressed multimedia object, text, caption and graphics data for output to On-Screen Display (OSD) and graphics generator 37. Unit 37 interprets and formats the multimedia objects and other data from unit 30 for presentation on unit 50. The formatted pixel mapped text and graphics data may represent multimedia objects or a program guide
25 or other type of menu or user interface for subsequent display on unit 50. Unit 37 also processes EIT, ETT and other information to generate pixel mapped data representing, subtitling, control and information menu displays including selectable menu options, and other items, for presentation on unit 50. The control and information displays enable function selection and entry of device operating
30 parameters for User operation of decoder 100.

The text and graphics produced by OSD generator 37 are generated in the form of overlay pixel map data under direction of processor 60. The overlay pixel map data from unit 37 is combined and synchronized with the decompressed pixel representative data from MPEG decoder 25 in encoder 45 via multiplexer 40 under
35 direction of processor 60. Thereby multimedia objects such as advertisements, web page data, interactive icons etc. may be included in program content or program guides for display. Combined pixel map data representing a video program and associated multimedia objects together with associated sub-picture text message data is encoded by NTSC encoder 45 and output to device 50 for display.

40 In a storage mode of the system of Figure 4, the corrected output data from unit 17 is processed by decoder 100 to provide an MPEG compatible datastream

5 for storage. In this mode, a program is selected for storage by a user via remote unit 70 and interface 65. Processor 22, in conjunction with processor 60 forms condensed program specific information including MGT, VCT, EIT and ETT data. The condensed program specific information supports decoding of the program selected for storage but excludes unrelated information. Processor 60, in conjunction with
10 processor 22 forms a composite MPEG compatible datastream containing packetized content data of the selected program and associated condensed program specific information. The composite datastream is output to storage interface 95.

Storage interface 95 buffers the composite datastream to reduce gaps and bit rate variation in the data. The resultant buffered data is processed by storage
15 device 90 to be suitable for storage on medium 105. Storage device 90 encodes the buffered datastream from interface 95 using known error encoding techniques such as channel coding, interleaving and Reed Solomon encoding to produce an encoded datastream suitable for storage. Unit 90 stores the resultant encoded datastream incorporating the condensed program specific information on medium 105.

20 The architecture of Figure 4 is not exclusive. Other architectures may be derived in accordance with the principles of the invention to accomplish the same objectives. Further, the functions of the elements of decoder 100 of Figure 4 and the process steps of Figure 3 may be implemented in whole or in part within the programmed instructions of a microprocessor. In addition, the principles of the
25 invention apply to any form of MPEG or non-MPEG compatible electronic program guide. A datastream formed according to the invention principles may be used in a variety of applications including video server or PC type communication via telephone lines, for example. A program datastream with one or more components of video, audio and data formed to incorporate program specific information according
30 to invention principles may be recorded on a storage medium and transmitted or re-broadcast to other servers, PCs or receivers.

CLAIMS

1. In a system for decoding packetized program information including ancillary program specific information comprising a plurality of hierarchically ordered information tables, said ancillary information being for use in acquiring and
10 decoding packetized program information to provide a video program for display, a method comprising the steps of:

detecting a mismatch between a version number of a first table of said program specific information and a corresponding version number of said first table conveyed in a second table;

15 forcing compatibility of said first table version number conveyed in said first and second tables in response to said detected mismatch; and

decoding packetized program information using program specific information including said first and second tables including said forced compatible version number to provide a video program for display.

20

2. A method according to claim 1, wherein

said first table comprises a channel map associating a transmission channel carrier frequency with data identifiers used to capture datastreams constituting a program conveyed on a broadcast channel, and

25 said second table contains information for acquiring program specific information conveyed in other tables including identifiers for identifying data packets comprising said first table.

3. A method according to claim 1, including the step of

30 examining said program specific information for error indications by examining at least one of, (a) an MPEG transport error indicator, (b) an MPEG discontinuity indicator, (c) an MPEG continuity counter, and

decoding said packetized program information in response to said examination determination of an error free condition.

35

5 4. A method according to claim 1, wherein
said second table conveys a plurality of version numbers
corresponding to version numbers conveyed in said plurality of hierarchically ordered
information tables, and said detecting step includes the step of,
 comparing individual version numbers of said plurality of
10 hierarchically ordered information tables against corresponding individual version
numbers conveyed in said second table.

 5. A method according to claim 1, wherein
said step of ensuring compatibility of said first table version number
15 conveyed in said first and second tables includes the step of,
 substituting a version number for said first table version number
conveyed in at least one of (a) said first table, and (b) said second table, to ensure
compatibility.

20 6. A method according to claim 5, wherein
said substituting step comprises overwriting said first table version
number conveyed in at least one of (a) said first table, and (b) said second table, to
ensure compatibility.

25 7. A method according to claim 1, wherein
said step of ensuring compatibility of said first table version number
conveyed in said first and second tables includes the step of,
 reverting to a previous version of at least one of (a) said first table, and
(b) said second table, to ensure version number compatibility.

30 8. A method according to claim 1, wherein
said step of ensuring compatibility of said first table version number
conveyed in said first and second tables includes the step of,
 initiating acquisition of at least one of (a) a new version of said first
35 table, and (b) a new version of said second table, to ensure version number
compatibility.

- 5 9. In a system for decoding packetized program information including ancillary program specific information comprising a plurality of hierarchically ordered information tables, said ancillary information being for use in acquiring and decoding packetized program information to provide a video program for display, a method comprising the steps of:
- 10 detecting a mismatch between a version number of a first table of said program specific information and a corresponding version number of said first table conveyed in a second table;
- decoding packetized program information by,
- disregarding said first table version number conveyed in said
- 15 first and second tables in response to said detected mismatch and by
- applying program specific information including information in said first table.
10. A method according to claim 9, including the step of,
- 20 examining said program specific information for an error condition
- and decoding said packetized program information in response to the absence of an error condition.
11. A method according to claim 10, wherein
- 25 said error condition is indicated by at least one of, (a) an MPEG transport error indicator, (b) an MPEG discontinuity indicator, (c) an MPEG continuity counter.
12. A method according to claim 9, wherein
- 30 said second table conveys a plurality of version numbers corresponding to version numbers conveyed in said plurality of hierarchically ordered information tables, and said detecting step includes the step of,
- comparing individual version numbers of said plurality of hierarchically ordered information tables against corresponding individual version
- 35 numbers conveyed in said second table.

- 5 13. In a system for decoding packetized program information including ancillary program specific information comprising a plurality of hierarchically ordered information tables, said ancillary information being for use in acquiring and decoding packetized program information to provide a video program for display, a method comprising the steps of:
- 10 detecting a mismatch between a version number of a first table of said program specific information and a corresponding version number of said first table conveyed in a second table;
- re-acquiring a first table of said program specific information in response to said detected mismatch;
- 15 examining said re-acquired first table and said second table for a mismatch of said first table version number; and
- inhibiting decoding packetized program information in response to said detected mismatch between said re-acquired first table and said second table.
- 20 14. A method according to claim 13, wherein
- said first table comprises a channel map associating a transmission channel carrier frequency with data identifiers used to capture datastreams constituting a program conveyed on a broadcast channel.
- 25 15. A method according to claim 14, including the step of
- indicating in a database said transmission channel is associated with said detected mismatch between said re-acquired first table and said second table.
16. A method according to claim 13, wherein
- 30 said second table contains information for acquiring program specific information conveyed in other tables including identifiers for identifying data packets comprising said first table.

5 17. In a system for decoding packetized program information including ancillary program specific information comprising a plurality of hierarchically ordered information tables, said ancillary information being for use in acquiring and decoding packetized program information to provide a video program for display, a method comprising the steps of:

10 detecting a mismatch between a version number of a first program specific information table comprising a channel map associating a transmission channel carrier frequency with data identifiers used to capture datastreams constituting a program conveyed on a broadcast channel and a corresponding version number of said first program specific information table conveyed in a second program
15 specific information table;

 indicating in a database said transmission channel is associated with said detected mismatch between said first table and said second table; and

 inhibiting decoding packetized program information in response to said detected mismatch between said re-acquired first table and said second table.

20

 18. A method according to claim 17, wherein

 said second table contains information for acquiring program specific information conveyed in other tables including identifiers for identifying data packets comprising said first table.

25

5 19. In a system for decoding packetized program information including ancillary program specific information comprising a plurality of hierarchically ordered information tables, said ancillary information being for use in acquiring and decoding packetized program information to provide a video program for display, a method comprising the steps of:

10 detecting a fault condition in program specific information comprising at least one of, (a) a version number incompatibility between a version number of a first table and a corresponding version number of said first table conveyed in a second table, and (b) a PSI error condition;

 indicating in a database said transmission channel is associated with
15 said detected fault condition; and

 removing a channel associated with said fault condition from a User's viewable active channel line-up list.

 19. A method according to claim 18, wherein

20 said PSI error condition comprises at least one of, (a) an MPEG transport error, (b) an MPEG discontinuity error, (c) an MPEG continuity count error, and (d) an error indicated by a variance between successive time stamps.

 20. A method according to claim 18, including the step of

25 indicating a channel as being associated with a fault condition in a User's viewable channel line-up list.

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MASTER GUIDE TABLE (MGT)

Syntax	Bits	Format
master_guide_table_section () {		
table_id	8	0xC7
section_syntax_indicator	1	'1'
private_indicator	1	'1'
zero	2	'00'
section_length	12	uimsbf
table_id_extension	16	0x0000
reserved	2	'11'
version_number	5	uimsbf
current_next_indicator	1	'1'
section_number	8	0x00
last_section_number	8	0x00
protocol_version	8	uimsbf
tables_defined	16	uimsbf
for (i=0;i<tables_defined;i++) {		
table_type	16	uimsbf
reserved	3	'111'
table_type_PID	13	uimsbf
reserved	3	'111'
table_type_version_number	5	uimsbf
number_bytes	32	uimsbf
reserved	4	'1111'
table_type_descriptors_length	12	uimsbf
for (k=0;k<N;k++)		
descriptor()	var	
}		
reserved	4	'1111'
descriptors_length	12	uimsbf
for (l = 0;l < N;l++)		
descriptor()	var	
CRC_32	32	rpchof
}		

FIG. 1

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VIRTUAL CHANNEL TABLE (VCT)

Syntax	Bits	Format
terrestrial_virtual_channel_table_section () {		
table_id	8	0xC8
section_syntax_indicator	1	'1'
private_indicator	1	'1'
zero	2	'00'
section_length	12	uimsbf
transport_stream_id	16	uimsbf
reserved	2	'11'
140 — version_number	5	uimsbf
current_next_indicator	1	bsibf
section_number	8	uimsbf
last_section_number	8	uimsbf
protocol_version	8	uimsbf
num_channels_in_section	8	uimsbf
for (i=0; i<num_channels_in_section; i++) {		
short_name	7*16	unicode™ BMP
reserved	4	'1111'
major_channel_number	10	uimsbf
minor_channel_number	10	uimsbf
modulation_mode	8	uimsbf
carrier_frequency	32	uimsbf
channel_TSID	16	uimsbf
program_number	16	uimsbf
ETM_location	2	uimsbf
access_controlled	1	bsibf
hidden	1	bsibf
reserved	6	'111111'
service_type	6	uimsbf
source_id	16	uimsbf
reserved	6	'111111'
descriptors_length	10	uimsbf
for (i=0; i<N; i++) {		
descriptors()		
}		
}		
reserved	6	'111111'
additional_descriptors_length	10	uimsbf
for (j=0; j<N; j++) {		
additional_descriptors()		
}		
CRC_32	32	rpchof
}		

FIG. 2

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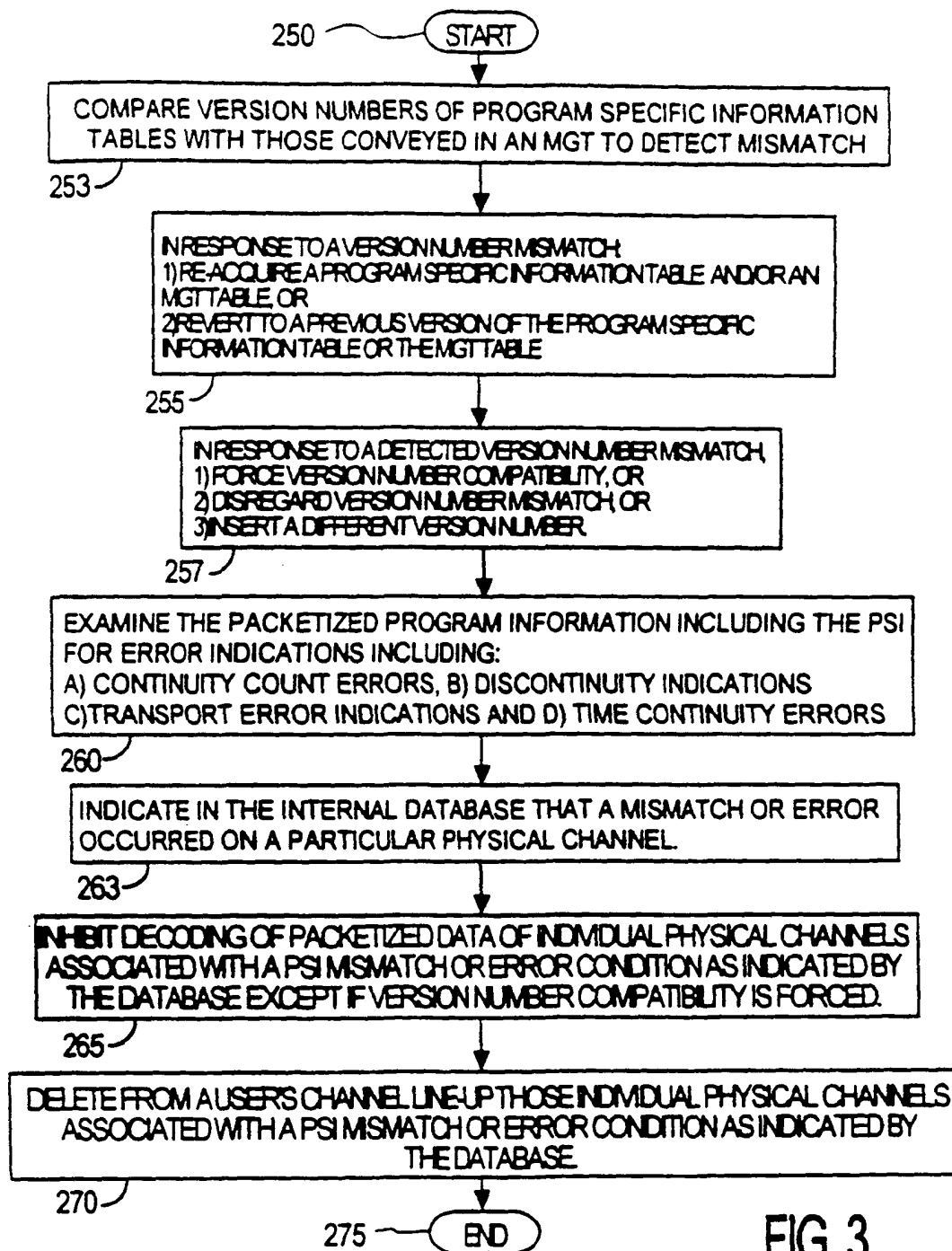


FIG. 3

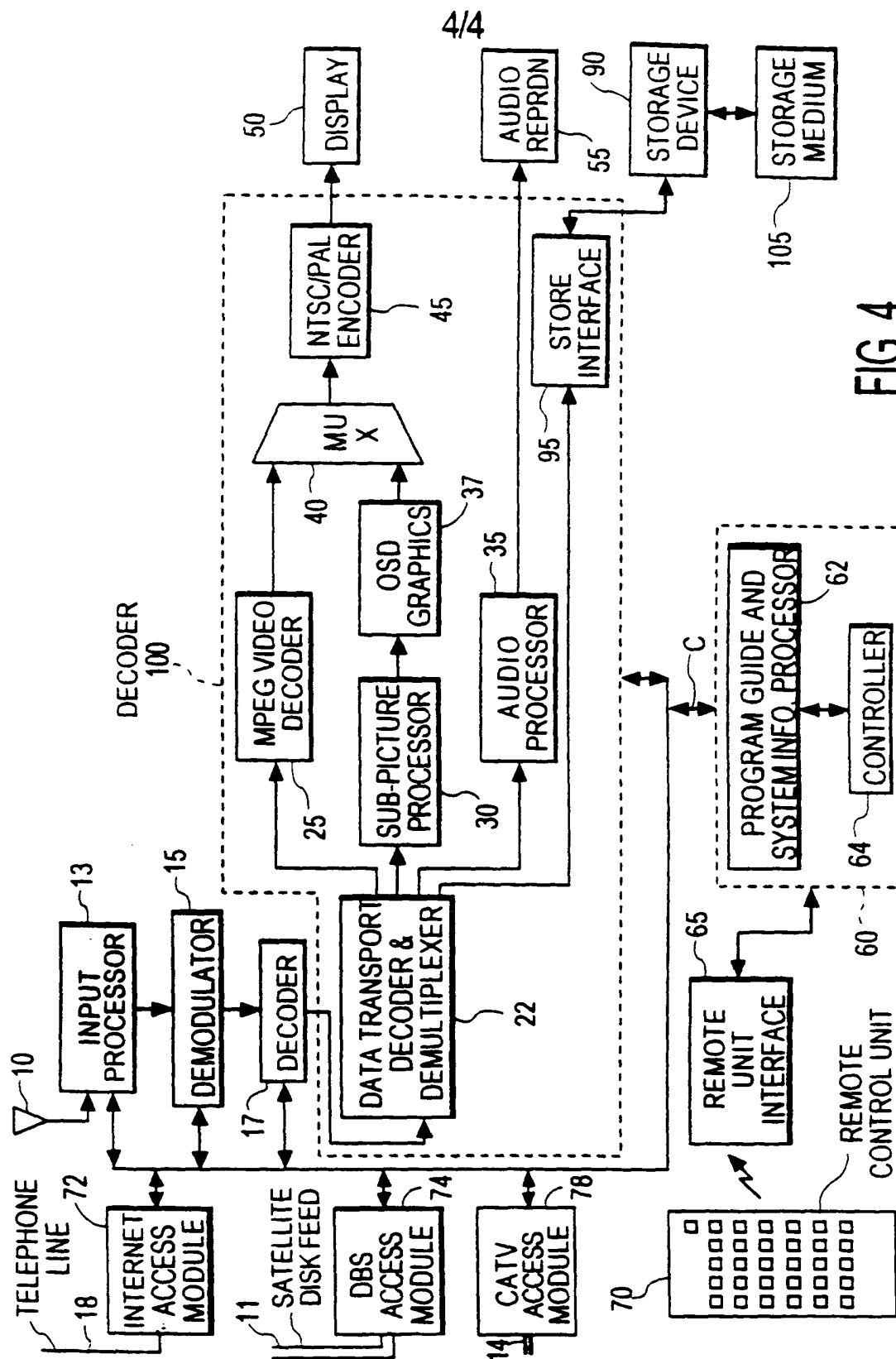


FIG. 4

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
18 January 2001 (18.01.2001)

PCT

(10) International Publication Number
WO 01/005157 A3

(51) International Patent Classification⁷: **H04N 5/00**

(21) International Application Number: PCT/US00/16928

(22) International Filing Date: 20 June 2000 (20.06.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/143,611 13 July 1999 (13.07.1999) US

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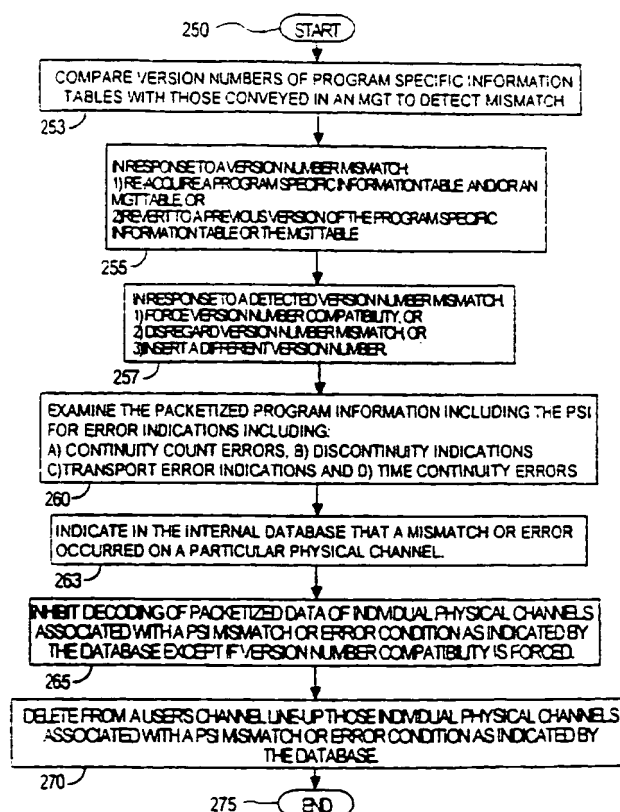
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(81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: SYSTEM FOR PROGRAM SPECIFIC INFORMATION ERROR MANAGEMENT IN A VIDEO DECODER



(57) Abstract: A processing system decodes packetized program information including ancillary program specific information comprising a plurality of hierarchically ordered information tables. The ancillary information is used in acquiring and decoding packetized program information to provide a video program for display. The processing system employs a method involving detection of a mismatch between a version number of a first table of the program specific information (e.g. a virtual channel table (VCT), or channel information table (CIT)) and a corresponding version number of the first table conveyed in a second table (e.g. a master guide table (MGT)). If a mismatch is detected, the first and second tables are forced to contain a compatible first table version number. The packetized program information is decoded to provide a video program for display using the program specific information including the first and second tables including the forced compatible version number. A detected mismatch may also be disregarded to enable the decoding of the packetized program information and a User's channel line-up may be edited to remove channels associated with a detected mismatch or other program specific information error condition.



WO 01/005157 A3



Published:

— with international search report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(88) Date of publication of the international search report:

12 September 2002

INTERNATIONAL SEARCH REPORT

International Application No.

PCT/US 00/16928

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04N5/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Date of the actual completion of the international search

5 October 2000

Date of mailing of the international search report

12/10/2000

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No.

PCT/US 00/16928

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